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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for September, 1887, and is based upon reports of regular and voluntary observers of both countries. Descriptions of the storms which appeared over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i, on which also appears the distribution of icebergs and field ice reported, and the limits of fog-belts to the westward of the fortieth meridian. In tracing the centres of the paths of these storms, data from the reports of two hundred and eighteen vessels have been used. The severest storms of the month over the north Atlantic attended the passage of two cyclones which are traced from northeast of the Windward Islands over the Banks of Newfoundland.

There was an almost entire absence of ice in the vicinity of the Newfoundland Banks, while to the northward of Newfoundland and in the Strait of Belle Isle the aggregate quantity observed slightly exceeded that reported for the preceding month.

Fog was more frequently encountered in the vicinity of Newfoundland than during August, and the southern and eastern limits of the fog-belts are somewhat extended.

The number of areas of low pressure for this month is about the average for September.

The month was warmer than the average September by from 2° to 4° in the Rocky Mountain districts; in the lower Mississippi Valley, west Gulf states, and on the Pacific coast the mean temperature was about normal, while over the greater part of the country east of the Mississippi the month was decidedly colder than the average.

Marked deficiencies in the monthly precipitation occurred in the south Atlantic and west Gulf states. In the Rio Grande Valley, southern plateau, and northern slope the precipitation was decidedly above the average. In all other districts it was near the normal.

In the preparation of this REVIEW the following data, received up to October 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-three Canadian stations, as telegraphed to this office; one hundred and seventy-two monthly journals and one hundred and sixty-nine monthly means from the former and twenty-three monthly means from the latter; two hundred and eighty monthly registers from voluntary observers; sixty monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Illinois, Indiana, Kansas, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, and Tennessee; and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for September, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The range of mean pressure for September, 1887, over the United States is .35, Yuma, Ariz., reporting the least, 29.77, while eastward of the Rocky Mountains four stations, viz., Toledo, Ohio, Washington City, Hatteras, N. C., and Atlantic City, N. J., report a mean of 30.12, the maximum for the month. From chart ii it will be seen that the region of least mean pressure, indicated by the isobar of 29.8, comprises a small area including parts of the southern plateau and south Pacific coast region, and that the mean pressure is greatest over the region extending from the central and upper portions of the Mississippi Valley eastward to the Atlantic coast, there being two areas of barometric maxima shown by the isobar of 30.1—one of which covers a part of the Lake region, and the other the states bordering on the Atlantic from Massachusetts to South Carolina. The barometric means exceed 30.0 in all parts of the country, with the exception of the Rocky Mountain region and Maritime Provinces of Canada.

As compared with the mean pressure of the preceding month, an increase is shown at all Signal Service and Canadian stations, except the following: Fort Canby, Wash., Swift Current and Minnedosa, N. W. T.; at these stations the means for the two months coincide. The increase over the August means is most marked in the middle Rocky Mountain region, and from the lower lakes and New England southward to the Gulf, where it generally ranges from .10 to .15; over the interior portions of the country the increase varies from .05 to .10, and along the Pacific coast from .01 to .05.

The departures from the normal for the various stations are given in the tables of miscellaneous meteorological data; they are also graphically exhibited on chart iii by lines connecting stations of normal or equal abnormal values. The mean pressure for this month is normal or slightly below over the Maritime Provinces of Canada, in the lower Mississippi valley and adjacent states, along the immediate southwestern border from the mouth of the Rio Grande to the Pacific, and in northern California and southern Oregon; in these districts the departures nowhere exceed .03. In all other portions of the country the mean pressure is above the normal, the departures being greatest over the region from the upper Missouri valley eastward to the lower lakes, where they range from .05 to .10.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the tables of miscellaneous meteorological data. In the extreme northwest the monthly ranges exceed the normal September ranges by about .2, while on the north Pacific coast they are about .1 less than the normal. At

Brownsville, Tex., an unusual range of 1.16 is reported; this range, which is due to the storm of the 20th–21st, is more than three times as great as the normal (.38) for September at that station. In all other districts the monthly ranges, as compared with the September normal, show no unusual features.

The following are some of the extremes for September, 1887:

Greatest.	Inch.	Least.	Inch.
Saint Vincent, Minn.	1.17	San Diego, Cal.	0.22
Rio Grande City, Tex.	1.16	Los Angeles, Cal.	0.25
Fort Totten, Dak.	1.12	Fort Thomas, Ariz.	0.26
Mount Washington, N. H.	1.11	Cedar Keys, Fla.	0.28
Newport, Vt.	1.07	Titusville, Fla.	0.28
Mackinaw City, Mich.	1.06	El Paso, Tex.	0.28
Moorhead, Minn.	1.06	Fort Davis, Tex.	0.28
Portland, Me.	1.03	Key West, Fla.	0.33

AREAS OF HIGH PRESSURE.

Eight areas of high pressure appeared within the limits of stations of observation during this month. September opened with a high area central in northern Virginia, and on the afternoon of the 1st another appeared to the north of Minnesota. The remaining six were first observed on the north Pacific coast. The general direction of movement was to the east, west of the eighty-second meridian, afterwards southeast until the limits of the coast were reached, and subsequently either east or northeast. The centres of paths were, as a rule, north of the forty-fifth parallel until reaching the region over the lower lakes when they trended more to the south. The cold waves which accompanied the passage of high area number v and the last two areas (numbers vii and viii) caused the most destructive frosts of the month, the latter two, especially, severely injuring tobacco and other products.

I.—An area of relatively high pressure, central in northern Virginia, extended on the morning of the 1st from northern Alabama, Georgia, and South Carolina in a northeasterly direction to the Gulf of Saint Lawrence, covering the Maritime Provinces, the New England and middle Atlantic states, the eastern portions of the Ohio Valley and Tennessee, and the northwestern part of the south Atlantic states. During the day the high pressure in the northeast moved rapidly to the east and off the Atlantic coast in advance of a low area which was then moving eastward from Lake Superior, but the southwest portion of the area, moving more slowly in the same direction, remained on the coast until the afternoon of the 2d. This area, whose maximum pressure was less than .2 above the normal, did not present during its passage any special features worthy of note.

II.—A second area first appeared to the north of Minnesota on the afternoon of the 1st. By midnight of the 2d its centre was apparently north of Lake Superior and its southern edge extended over the Lake region. As it slowly advanced southeastward the pressure steadily increased, and on the morning of the 4th the barometer at Rockliffe, Canada, near which the maximum pressure seemed central, was reported as 30.36, or .33 above the normal. The high area at this time extended eastward from the Mississippi River to the Atlantic coast and southward to the Gulf and Florida. During the day it changed its direction more to the southward and moved rapidly, with decreased pressure, to the middle Atlantic states. On the 5th its centre passed beyond the limits of our coast stations and on the 6th the entire area disappeared, apparently continuing its movement to the southeast. In the latter part of the progress southeastward it preceded a low area moving across the Lake region, which advanced so rapidly as to produce moderate gradients of pressure on the 6th, causing dangerous winds both on the upper and lower lakes.

III.—Midnight reports of the 4th indicated an area of pressure above the mean in the eastern portion of Washington Territory which apparently had moved inland from the north Pacific coast. By the morning of the 5th it had extended eastward into northern Idaho and Montana, where it still manifested its presence at the midnight reports, though the pressure had decreased until but slightly above the normal. On the morning of the 6th, however, it had moved southeastward and was central in northwestern Montana, with a maximum pressure of .1 above the normal. By the morning of the 8th it had progressed into Wisconsin, causing light frosts in the northern portions both of that state and Michigan, where the temperature reported at 7 a. m. ranged from 4° to 13° below the mean. It continued to move slowly towards the Atlantic, its general direction being southeast, though from the afternoon of the 7th to the morning of the 8th its mean direction was east, and passed off the coast of the middle Atlantic states on the 9th. Although the maximum pressure throughout the entire path varied only about .1 from the normal, and neither the gradients nor changes in temperature were specially marked, yet its passage across the country to the south of two areas of "low," one preceding and the other succeeding, aided materially, in connection with high areas numbers ii and iii, in causing heavy rains and gales on the Lakes and adjacent regions from the 6th to the 9th, inclusive.

IV.—This area was first observed on the night of the 8th in the northwest off the coasts of Washington Territory and British Columbia. By the morning of the 9th it had moved rapidly inland and was central in British America south of the Saskatchewan River and north of Dakota and Montana. Its subsequent path during the next eight hours was southeasterly into Dakota, where a pressure of 30.32, .4 above the normal, was reported from Bismarck at the afternoon report, and depressions of temperature, both at that station and others in the vicinity, of from 12° to 14° below the average. During the night of the 9th it moved with increased energy northeastward to Lake Superior, causing killing frosts in the northern parts of the upper lake region and reducing the temperature generally throughout the Lake region, upper Mississippi and eastern portion of the Missouri valleys. By the morning of the 11th it had moved eastward and was apparently central near Rockliffe, Canada, where a pressure of 30.50 was reported and a temperature of 34°, 16° below the normal. Killing frost was reported at Northfield, Vt., where the temperature was also 34°. During the next eight hours it moved southeast to the New England coast and, subsequently changing direction to northeast, passed over the Maritime Provinces and disappeared on the 12th from the north Atlantic coast.

V.—The high area which had been stationary on the north Pacific coast since the afternoon of the 9th had, on the morning of the 12th, advanced into western Oregon, where it was central, with a pressure of .25 above the normal. The advance wave of this area crossed the Rocky Mountains during the succeeding night, causing light frosts on the northern slope, but the maximum pressure still remained west of the mountains, central in Oregon. By the afternoon of the 13th the area had partially divided, the eastern wave, with a maximum pressure of .21 above the average, was central in Kansas, and the western, in the north Pacific region, where the highest pressure, 30.30 (.27 above the normal), was reported at Portland, Oregon. On the morning of the 14th the primary area was in motion eastward, and during the next eight hours crossing the northern plateau and Rocky Mountains was central on the northern slope at the afternoon report. Advancing more slowly it crossed into Dakota, where it caused severe frosts during the night, and by the morning of the 15th had united with the secondary area which had been slowly moving northeastward from Kansas towards the lower lakes. The pressure, which was now greatest in northeastern Dakota, where a barometer reading of 30.52 (.56 above the mean) was reported, had increased during the translation of the area and was above the normal over the entire country, except in California, portions of the eastern Gulf and Atlantic states, and New England, and the temperature in Minnesota and Dakota ranged from 4° to 17° below the mean. During the succeeding night as the area moved eastward it caused destructive frosts in the northern portions of Wisconsin and Michigan, and also light frosts in the southern parts of the latter. It advanced steadily, changing its course to southeast as it approached

the Atlantic coast, and on the 19th moved off in advance of high area number vi approaching from the west.

VI.—This high area moved rapidly inland from the coasts of Washington Territory and British Columbia on the night of the 16th, reducing the temperature in Washington Territory from 6° to 18° below the normal, and causing local frosts. On the morning of the 17th the maximum pressure, which was about .17 above the average, was central in northern Montana and the adjacent border of the British Possessions while the area covered the northern slope and extended westward over Idaho and Washington Territory. The pressure increased as its centre progressed eastward north of the Lake region until on the morning of the 19th it ranged, in northern Michigan, from .33 to .44 above the normal. During the succeeding night it changed direction to the southeast and was central over Lake Ontario on the morning of the 20th. Within the next eight hours the maximum pressure decreased about .1. It subsequently moved southeast, with no marked changes in energy, and on the 21st passed off the middle Atlantic coast.

VII.—On the morning of the 19th another high area appeared off the coast of Washington Territory and had by midnight progressed inland so as to cover the northern plateau and north Pacific regions, except the southwestern portion of Oregon. Increasing in pressure it moved slowly across the Rocky Mountains, accompanied by low temperatures and local frosts, and on the morning of the 22d was central north of Dakota. Moving afterwards to the southeast it caused light frosts in Minnesota and portions of the adjoining states on the night of the 22d. On the morning of the 24th the maximum pressure was central in southern Michigan and northern Illinois and numerous frosts were reported both from these states and adjacent portions of others. The temperature reported from that vicinity in some instances fell to 24° below the average, and was below the normal over the entire country east of the Rocky Mountains, except at a few stations in the eastern portions of the northern and middle slopes where the variations from the normal were but slight. Light frost was also reported from Nashville, Tenn., on that morning. During the succeeding night light frosts were reported in Tennessee and Virginia, injuring the tobacco crop at Lynchburg, Va. As the area continued its progress southeastward the pressure decreased, but the low temperatures continued, and on the night of the 25th frosts, which were numerous, especially in the lower lake region, the Ohio Valley, and middle Atlantic states, seriously damaged tobacco and other products. It crossed the middle Atlantic states on the 26th, and apparently passed off afterwards to the northeast, moving in a direction parallel to the coast.

VIII.—Morning reports of the 25th indicated the presence of this high area off the north Pacific coast. Moving southeastward it was central in the northern slope on the morning of the 27th and had caused severe local frosts in that region on the preceding night. Except in portions of the northern and middle plateaus, northern slope, and the north Pacific coast regions the temperature on the morning of the 27th over the entire country was below the normal, and in advance of the low area moving northward from the Gulf copious rains fell east of the ninety-seventh meridian from the 26th, at intervals, up to the close of the month. On the morning of the 28th the centre of the high area was in northern Nebraska and southern Dakota, in which, as also in the adjoining regions, it had caused heavy frosts during the preceding night. Temperatures ranged in some instances from 20° to 24° below the normal in that vicinity. During the next twenty-four hours the pressure rapidly declined under the influence of the low area moving northward in the Mississippi Valley, and by the afternoon of the 29th the high area had entirely disappeared and the barometer fallen to the normal.

AREAS OF LOW PRESSURE.

The paths of eleven low areas have been more or less definitely traced on chart i, dependent upon the information had regarding them. The month is remarkable mainly for the absence of barometric disturbances within the United States, only one depression of any magnitude (number xi) having an extended path within their limits. Five depressions either developed or were first observed in the Saskatchewan Valley. One hurricane moved inland from the Gulf near Brownsville, Tex., and caused much damage generally in that vicinity. One storm moved northeastward from the Rio Grande Valley to the eastern Gulf states and thence northerly, with minor deflections, towards the eastern coast of Lake Superior. One slight depression moved eastward from the shores of Lake Superior. Another entered at the southern coast of Nova Scotia, passed northward to the Saint Lawrence, and thence moved eastward. One low area developed in the middle plateau region, moved northward into the Saskatchewan Valley and subsequently eastward, and another moved from southern California northeastward to the eastern coast of Lake Winnipeg and afterwards apparently eastward. The general course of depressions was eastward, the paths of the majority being in the Saskatchewan Valley, through the British Possessions north of the Lake region, and down the Saint Lawrence Valley.

The following table shows the latitude and longitude in which each area of low pressure was first and last observed and the average hourly velocity of each:

Areas of low pressure.	First observed.		Last observed.		Average progress in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
	° ′	° ′	° ′	° ′	
No. I	47 00	86 00	45 00	62 00	19.0
II	53 00	107 00	49 00	60 00	30.0
III	39 00	117 00	49 00	58 00	36.0
IV	52 30	114 00	52 00	62 00	19.0
V	52 00	116 00	52 00	93 00	21.0
VI	36 00	119 00	49 00	56 00	26.0
VII*	13 00	57 00	26 00	99 00	10.0
VIII	53 00	115 00	52 00	91 00	25.0
IX	52 00	114 00	53 00	99 00	22.0
X	42 00	66 00	52 00	63 00	25.0
XI	28 00	99 00	45 00	86 00	18.0

Average rate of progress, 22.8 miles per hour.

* This storm was evidently the continuation of north Atlantic storm number 5, and its first location and average progress include its ocean path prior to its arrival on the Gulf coast.

I.—The month opened with an area of low pressure covering the middle and southern slopes, extending westward to the Pacific and northeastward, in a narrow belt across the northern limits of the upper Mississippi and Missouri valleys and the upper lake region, into the British Possessions. The temperature east of the Rocky Mountains was above the normal, except in the region bounded by a line running diagonally from the shore of Miramichi Bay along the northern coast of Lakes Erie and Ontario southwestward to the northeast border of the Indian Territory and thence southerly to the Gulf, west of Galveston, Tex. Local rains, generally light, were reported mainly from the Mississippi and Missouri valleys and upper lake region. The minimum pressure remained in the southwest, probably in consequence of the high areas in the east and north, but a secondary depression which on the morning of the 1st was central over the eastern portion of Lake Superior began to move eastward. As it progressed north of the Lakes it was succeeded by an area of high pressure, which caused heavy rains generally on the 2d from the Mississippi River eastward through the Lake region and northern New England. Brisk and also in a few instances high winds dangerous to navigation were reported on the 2d and morning of the 3d from a few of the Lake stations. The depression continued its easterly movement over northern New England and the Maritime Provinces, reaching the coast on the night of the 3d, generally attended by light local rains and fresh to brisk winds.

II.—Afternoon reports of the 5th indicated the presence of a well-defined area of low pressure in the Saskatchewan Valley, north of Montana. Moving southeastward, with increasing energy, it was central over Lake Superior on the afternoon of the 6th, producing heavy rains and gales generally throughout the Lake region. By the morning of the 7th the pressure had still further decreased, the barometer at Rockliffe, Canada,

near the centre of the depression, reading 29.22 at the a. m. report, .81 below the normal. Gales had increased in violence on the Lakes, maxima velocities of forty miles being reported both on Lakes Michigan and Huron, and tornadoes and severe local storms occurred on the afternoon of the 6th and morning of the 7th in southern Michigan and northwestern Ohio, demolishing buildings and damaging property very extensively. The depression subsequently moved down the Saint Lawrence Valley on the 7th and 8th, accompanied by local rains in the lower lakes and the northern portions of the middle Atlantic states and New England, and by the morning of the 9th had passed beyond the limits of the coast. High winds still continued at some Lake ports, owing to the inequalities of pressure due to the movement of this depression, the approach of another low area from the Northwest, and the passage south of the Lakes of a high area towards the east.

III.—The depression which on the morning of the 6th seemed to be located off the coasts of northern California and Oregon had by the afternoon moved inland and become central over Nevada. Influenced by the high pressure then eastward on the mountains, it first moved to the north and subsequently to the northeast, and crossing Idaho and Montana on the afternoon of the 7th passed into the southern Saskatchewan valley. Light local rains fell in the coast regions and eastward, both on the plateaus and mountain slopes; passing to the southeast on the night of the 7th the low area was central in northwestern Dakota and the adjacent region of Montana on the morning of the 8th, with a maximum pressure of 29.50, .43 below the normal. Affected by the high area to its southeast it moved northeastward during the next eight hours, but subsequently trended to the southeast north of the boundary of the United States, and was accompanied in the upper lake region and the valleys westward by light local rains and fresh to brisk winds, occasionally high in the former. After the morning of the 9th, when it was central north of Michigan, its general direction was northeast down the Saint Lawrence Valley, and in its passage it was attended by heavy local rains and gales throughout the Lake region both on the 9th and 10th, and lighter rains eastward towards the Atlantic coast. No marked changes of energy occurred during translation.

IV.—This disturbance first appeared north of Montana, near the sources of the Saskatchewan, on the afternoon of the 9th to the northwest of a high area then in progress eastward. Moving slowly to the southeast, retarded by this high area, on the night of the 10th it changed direction more to the south and passed into northwestern Dakota, where it was central on the morning of the 12th. Heavy rains had fallen during the preceding night in portions of the northern slope, and still continued at a few stations, while numerous light rains were reported both in that region and those adjacent. Afterwards trending to the northeast it passed into Manitoba, with increasing energy, and at the midnight report of the 12th was central near the lakes on its northern border, with a pressure of about .65 below the normal. Rainy and cloudy weather prevailed in Manitoba, eastern Montana, northern Dakota, and from Iowa and Minnesota eastward to the Atlantic coast and the Maritime Provinces. The subsequent general course of this area was northeastward through the British Possessions toward the northern shore of the Gulf of Saint Lawrence, which it reached on the morning of the 15th and afterwards passed beyond the limits of observation. Rains and heavy gales occurred on the Lakes on the 13th and 14th during its progress farther north.

V.—Afternoon reports of the 15th indicated the presence in the western Saskatchewan valley, north of Montana, of another low area in the vicinity but farther to the westward of the region where the preceding depression had been first located. Retarded in its movements by the high area west of the upper lakes, its progress during the next eight hours was slow, but as the high pressure advanced eastward it moved more rapidly and by the afternoon of the 17th was apparently central in the British Possessions east of Lake Winnipeg, its passage so far north being due to higher pressure southward. Its subsequent path could not be definitely traced, though there were evidences both over the Lakes and the Saint Lawrence Valley of the passage of a low area to the northward, which apparently passed eastward north of the Gulf of Saint Lawrence on the night of the 19th. A few high local winds were reported at Lake stations, except from those on Ontario, during the 17th and 18th, but no other features of special interest or importance attended its progress.

VI.—A trough of low pressure was reported in eastern California and southwestern Nevada on the morning of the 17th. During the next twenty-four hours it moved northward, with but feeble energy, and expanded its limits so as to embrace the region from the Colorado River and northern and middle plateaus westward to the Pacific. Influenced by a high pressure which entered from the north Pacific coast and by a high area to the east, the centre contracted, moved to the northeast with increasing energy, and passing into the British Possessions crossed the lakes north of Manitoba. From the night of the 19th its future course appeared to be eastward towards the Gulf of Saint Lawrence, which it reached on the 22d, and during the succeeding night apparently passed over Newfoundland into the Atlantic. Its progress north of the Lakes and the Saint Lawrence River, in conjunction with the high area which followed it farther south, produced numerous local rains from the Missouri Valley eastward over the Lake region and New England and the adjacent states south, and also in the Maritime Provinces. High local winds were reported on the 20th and 21st on the upper lakes and on the 22d from various ports on Lakes Michigan, Huron, and Erie.

VII.—This depression, whose path was almost wholly beyond the limits of observation, was first reported in a telegram to the Chief Signal Officer on the morning of the 16th as a cyclonic disturbance to the southwest of Cuba. Subsequent reports received from marine observers by mail showed, however, that it was first observed in N. 13° 00′, W. 57° 00′. (For additional data, in connection herewith, see description of north Atlantic storm number 5, given elsewhere in this REVIEW.) Twenty-four hours afterwards, with slightly increased energy, it was approximately central on the northeastern coast of Yucatan. The pressure at this time over the United States to the east and south of a line drawn diagonally from the western coast of Lake Superior to Yuma, Ariz., was above the normal, except in portions of the Gulf States and Florida, where the departures from the mean were but very slight. The maximum pressure, nearly .5 above the mean, was central northeast of the lower lakes, the gradients gradually decreasing to the south and west. Another high area had, also, but a few days previously moved off the coast into the north Atlantic, where the pressure was probably considerably above the mean near the coasts of the United States. The high pressure to its north apparently aided materially in determining the path of the cyclone, which approximately moved to the northwestward over the northern portion of the peninsula of Yucatan towards the southern coast of Texas.

By the courtesy of Padre B. Viñes, S. J., Director of the Magnetic and Meteorological Observatory at Belen College, Havana, Cuba, the Chief Signal Officer was notified of the presence of the cyclone in the vicinity of the West Indies, and its subsequent progress through the Gulf. Timely warnings were issued and the public fully apprised, both by the display of signals and the publication of special messages.

The disturbance continued to move slowly in the same general direction during the 17th, 18th, 19th, and 20th, attended by local rains in the Gulf and south Atlantic states, and by high local winds and gales from north to east on the Gulf coasts on the 19th and 20th. At the last report on the night of the 20th it was approximately central about one hundred miles to the east, and slightly to the north, of the mouth of the Rio Grande. The pressure at this time was above the normal over the entire country, except on the southern shore of Lake Superior, portions of northern California, Nevada, and Oregon,

where the variations from the mean were very slight, and in a narrow border along the coast of the west Gulf states and Rio Grande Valley, where the maximum depression below the normal, .18, then existed at Corpus Christi and Brownsville, Tex. Centres of high areas were in the north of the middle Atlantic states and northern Montana, averaging about .3 above the normal. Gradients were beginning to be close on the coasts of Texas. By the morning of the 21st the cyclone had apparently moved westward and slightly to the south and was approximately about fifty miles east of the mouth of the Rio Grande. The barometer at Brownsville, Tex., about twenty miles inland on the river, had fallen nearly .3, and read .38 below the reading reported from Rio Grande City, Tex., ninety miles westward. The gradients between were in consequence very marked, averaging about one-tenth of an inch in twenty-four miles. Heavy rain had fallen in the vicinity and still continued, and high winds and gales from north to east prevailed on the coasts of Texas, but had subsided on the Gulf coast eastward.

Within the next eight hours the barometer at Brownsville fell .52 as the cyclone approached the vicinity, the reading at the afternoon report being .84 below that at Rio Grande City. The gradients between were remarkably close, about .1 in eleven miles, while northward towards Corpus Christi, Tex., about one hundred and thirty-two miles distant, the average was about one-tenth of an inch in sixteen miles. Very heavy rain had fallen at Brownsville, 4.96 inches in the preceding eight hours, and still continued; the gale had also increased in fury, reaching a maximum of seventy-eight miles from the north at 1 p. m., and a current velocity of forty miles per hour was reported from the northwest. A high wind from the northeast still continued at Corpus Christi and a maximum velocity of forty-five miles was reported during the eight hours previous. At Key West, Fla., a maximum velocity of thirty miles had occurred during the previous eight hours, but the current velocity reported showed a subsidence below that considered as dangerous to navigation. Local rains generally light, except in the vicinity of Brownsville, where they were very excessive, had fallen both on the Gulf coasts and the eastern coast of Florida. The centre of the hurricane, about 4 p. m., was approximately a few miles to the southeast of Brownsville, moving slightly south of west. Soon afterwards the heavy rains changed to light and the barometer began to rise, but the gale still continued, with but slight abatement.

By the morning of the 22d the hurricane was approximately south, and a little to the east, of Rio Grande City, moving southwest into Mexico. Eight hours later it seemed to have advanced farther to the southward and westward beyond the limits of observation. During the 21st and on the morning of the 22d the gale materially damaged property, especially from Brownsville eastward on the Rio Grande to the coast, demolishing trees, fences, houses, etc., and at Point Isabel, Tex., tearing smaller craft from their moorings and carrying them into the Gulf. The greatest damage, however, was probably due to the heavy rains and the floods in the river and adjacent lowlands, which destroyed cattle and other live stock and materially injured cotton, sugar cane, and exposed products. While the damage that occurred was very extensive it would seem that first reports were materially exaggerated and, owing to the timely warnings given in advance and the precautions taken in consequence, the actual losses to property were very materially lessened. By the afternoon of the 22d the winds had subsided and the rains had generally ceased, though they still continued lightly at San Antonio and Rio Grande City, where they also ceased during the next eight hours. At Galveston, Tex., high winds prevailed during the 19th and 20th; a maximum velocity of forty miles per hour from the northeast was recorded during the forenoon of the latter date.

The Signal Service observer at Corpus Christi, Tex., reports as follows:

Brisk to high northerly winds prevailed on the 19th until 5 p. m., when the wind veered to northeast; it backed to north at 8.15 p. m., and attained its maximum velocity, thirty-three miles per hour from the north, at 9.17 p. m. High northerly winds prevailed during the 20th, attaining a maximum velocity of thirty-six miles. During the early morning of the 21st heavy rain fell, and light to heavy rain continued until 9 p. m. on that date. The wind veered to northeast and attained a velocity of forty miles per hour at 1.10 a. m., backing to north at 6.30 a. m., and then veering to northeast it reached its maximum velocity of forty-five miles per hour at 12.25 p. m.; brisk to high winds continued during the remainder of the day. The water in Corpus Christi Bay rose about 2½ feet from the 19th to the 21st.

Sergeant A. B. Crane, Signal Corps, Brownsville, Tex., reports, concerning this storm, substantially as follows:

For several days prior to the 21st the winds which were light to fresh in force were from north to northeast; the temperature was slightly below the mean; fair weather prevailed, with cumulo-stratus clouds predominating; the barometer was below the normal, and fluctuated but slightly, until the night of the 20th, when it fell rapidly. The telegraphic advices received from the office of the Chief Signal Officer (through the observer at Corpus Christi, Tex.), regarding the movements of the cyclone were placed before the public, and had therefore warned the inhabitants of, and prepared them for, the approaching dangerous storm.

A light drizzling rain set in at 2.20 p. m. on the 20th and continued until 11 p. m., when the rain increased to "heavy" and subsequently to "very heavy." At 7 a. m. of the the 21st the barometer read 29.45, wind ne., twenty-five miles per hour, and heavy rain. The barometer continued to fall steadily until at 1.45 p. m., when a minimum of 28.93 was reached; then the pressure seemed to fluctuate slightly, but by 2.15 p. m. had risen to 28.96; by 4 p. m. the barometer had again fallen to 28.93, but shortly afterwards began to rise rapidly.

The following table shows the readings of the barometer, with direction and velocity of the wind, at Brownsville during the storm:

Date.	Time. (75th meridian.)	Barometer (reduced to sea-level).	Wind.		Date.	Time. (75th meridian.)	Barometer (reduced to sea-level).	Wind.	
			Direction.	Velocity, miles per hour.				Direction.	Velocity, miles per hour.
		Inches.					*Inches.*		
20	10.00 p. m...	29.92	nw.	15	21	3.15 p. m....	28.96	nw.	36
21	7.00 a. m....	29.45	ne.	25	21	3.30 p. m....	28.94	nw.	36
21	1.00 p. m....	29.00	n.	78	21	4.00 p. m ...	28.93	nw.	18
21	1.15 p. m....	28.97	n.	50	21	4.30 p. m....	28.94	nw.	12
21	1.30 p. m....	28.94	nw.	40	21	5.00 p. m....	28.96	nw.	11
21	1.45 p. m ...	28.93	nw.	53	21	5.30 p. m....	28.98	w.	9
21	2.00 p. m...	28.95	nw.	43	21	6.00 p. m....	29.03	w.	12
21	2.15 p. m ...	28.96	nw.	40	21	10.00 p. m..	29.37	se.	24
21	2.30 p. m ...	28.95	nw.	37	22	2.00 a. m....	.....	s. and se.	60
21	2.45 p. m....	28.95	nw.	45	22	7.00 a. m....	29.74	se.	17
21	3.00 p. m....	28.95	nw.	38					

At Point Isabel, Tex. (situated about twenty-three miles northeast of Brownsville), the wind on the morning of the 21st blew from the northwest and north, shifting to the northeast and east and finally to the south, while at Brownsville, same time, the wind came from the northeast, backing to the northwest and west and finally to south. The maximum velocity attained at Brownsville was seventy-eight miles per hour at 1 p. m. (75th meridian time) of the 21st; afterwards the wind decreased in force until at 4.10 p. m., when a lull occurred, and to all appearances the storm seemed to be over; between 4.10 to 5 p. m. the wind became variable, swinging in all directions, and by 6.45 p. m. it had backed to the southwest and began blowing at a high rate, increasing in force to sixty miles per hour. The lull at Point Isabel began at 11 a. m., and lasted until about sunset.

At Brownsville, the wind of sixty miles, south and southeast, at 2 a. m. of the 22d caused more damage to the city and vicinity than did the higher velocity of seventy-eight miles, north, at 1 p. m. on the 21st. This the observer considers due to the fact that the inhabitants protect their homes and property against the "northers" and high northerly winds more so than against the south winds. Many fences, trees, and small houses, principally of Mexican construction, consisting of but the lighter building materials, were blown down, and the streets presented a picture of devastation.

The greatest damage reported occurred from the effects of the heavy rains and the flooding of the Rio Grande River. The river banks were overflowed and the flats and bottoms filled with water, although the streets were not flooded. The roads leading into Brownsville became impassable and up to this writing (October 6) their condition remains unchanged. At Point Isabel the sloop "Romp," the schooner "Mignonette," and the yacht "Maud B" were lost sight of and have not been heard from since. The "Mignonette" was a Government light-house boat, and had a crew of fourteen persons. Around and about Brownsville no great damage was sustained either to property real or personal, and this fact is largely due to the warnings issued by the Signal Service, as the inhabitants were busily engaged in nailing up their windows and fences, bracing their houses, and taking other precautions against damage, when the storm was reported as coming toward southwest Texas. The newspaper correspondents erroneously reported one million dollars damage. The reports were written on the day of the storm, when, to all appearances, that estimate seemed justifiable; but after the storm had passed and the actual damages estimated, it is found that $10,000 will fully cover all losses to property. The United States military telegraph line was blown down in several

places and could have been easily repaired, but for the flooded condition of the country along the river by which the line runs.

The following table shows the rainfall, in inches, at Brownsville during the storm:

Date.	Time, 75th meridian.			Total.
	7 a. m.	3 p. m.	10 p. m.	
Sept. 20	0.00	0.00	0.02	0.02
21	1.60	4.96	1.94	8.50
22	1.88	0.38	0.00	2.26
				10.78

Reports received from Santa Maria, Tex., twenty miles northwest of Brownsville, indicate that the winds and rains experienced there were about the same as at Brownsville.

Mr. Egan, of Point Isabel, furnishes, through the observer at Brownsville, the following record of observations taken during the storm:

Observations at Point Isabel.

Date.	Time. (75th meridian.)	Barometer.	Direction of wind.	Remarks.
		Inches.		
Sept. 20	7.10 p. m....	29.73	nw.	Water high; drizzling rain.
21	7.30 a. m....	29.12	nw.	Hurricane since 4 a. m.
21	9.50 a. m....	28.76	n.	Do.
21	10.45 a. m..	28.74	ne.	Wind weakening.
21	11.00 a. m..	28.74	ne.	Wind very light.
21	11.45 a. m..	28.77	ne. by e.	Do.
21	12.30 p. m..	28.79	e. by s.	
21	12.40 p. m..	28.82	se.	Wind fresh; water falling fast.
21	1.45 p. m....	28.98	se.	Wind fresh.
21	2.30 p. m....	28.98	se.	Do.
21	3.10 p. m....	29.00	se.	Do.
21	4.30 p. m....	29.12	se.	Do.
21	6.40 p. m....	29.27	se.	Do.
21	8.10 p. m....	29.40	se.	Do.
21	8.55 p. m....	29.44	se.	Do.
21	11.40 p. m..	29.56	se.	Wind fresh; stronger.
22	7.30 a. m....	29.76	s.	Wind moderate; very heavy rain.
22	8.30 a. m....	29.83	s.	Wind moderate.
22	11.00 a. m..	29.88	s.	Do.

NOTE.—Glass stands in ordinarily good weather with easterly winds at 30.00 inches; elevation above sea, eleven feet.

The Chicago "Times" of the 24th contained the following:

MATAMORAS, MEXICO, *September* 23.—The great storm of Wednesday (21st) night and yesterday morning did extensive damage in Matamoras and for twenty miles south of here and forty miles west along the Rio Grande. Telegraph wires were prostrated, preventing early accounts of the storm. The wind reached the velocity of a hurricane, blowing eighty-five miles an hour, as registered at the headquarters of the Mexican troops located here. The hurricane drove the sea into the mouth of the Rio Grande, causing it to overflow its bank on the Mexican side for a distance of nearly a hundred miles from its mouth.

The principal streets in Matamoras were submerged to a depth of three feet. Many old houses in the city collapsed and were carried away by the wind and flood. Notwithstanding the great destruction to property, no lives are yet known to have been lost, but many people were wounded by flying débris and falling houses. Narrow escapes from death are recounted by hundreds. The hurricane was so powerful that not a single metal roof remains in the city. They were all curled up like so much paper and hurled to the ground. All fences in the city and for miles surrounding have disappeared. In many instances not a single board is left on the ground—nothing but the naked posts. It is thought that every frame house in the city was moved more or less from its foundation or otherwise damaged.

During, and immediately following, the progress of the storm rescuing parties were organized and sent out to relieve people in the lagoon districts of the city, where the flood was dangerously deep. The rain poured down in blinding sheets for several hours, adding terror to the hurricane and the raging river. The government troops were all called out to assist the police in the work of rescue. The public school and government buildings are now crowded with refugees, whose homes have disappeared. Not less than a hundred small houses (jacals) were destroyed, while all of the larger buildings and residences are damaged. The Matamoras and Rio Grande Railroad sustained serious loss. Its track is swept away for many miles along the river, and its depots demolished. The federal and state authorities are feeding the homeless victims of the storm. Matamoras suffered much greater damage than Brownsville.

The following telegraphic warnings concerning this storm were issued from the office of the Chief Signal Officer:

WASHINGTON CITY, *September* 16, 1887—12.40 p. m.

Secretary Maritime Exchange, New York City; observers at New Orleans, Mobile, Cedar Keys, Key West, Galveston, Pensacola, Corpus Christi:

The following has been received from Havana, Cuba, this morning: "Storm-centre southwest of station; cyclonic disturbance; additional information will be given later." CRAIG.

WASHINGTON CITY, *September* 16, 1887—6 p. m.

Secretary Maritime Exchange, New York City; observers at New Orleans, Mobile, Cedar Keys, Key West, Galveston, Pensacola, Corpus Christi:

Afternoon special from Havana, Cuba, reports the cyclonic disturbance as central southwest of that station, and probably moving westward with slightly increasing energy. CRAIG.

WASHINGTON CITY, *September* 18, 1887—5.40 p. m.

Secretary Maritime Exchange, New York City, and to Collector of Customs, Appalachicola, Fla.:

The cyclone reported Saturday (17th) as moving into the Gulf is apparently approaching the central and western Gulf coasts. Northeasterly gales are indicated, except on southern Texas coast, with rain. CRAIG.

WASHINGTON CITY, *September* 20, 1887—10 a. m.

Secretary Maritime Exchange, New York City:

The cyclone is central off the western Gulf coast. Easterly gales have occurred from Galveston to Pensacola. CRAIG.

WASHINGTON CITY, *September* 21, 1887—10.20 a. m.

Secretary Maritime Exchange, New York City: observers, Key West, Cedar Keys, Pensacola, Mobile, New Orleans, Galveston, and Corpus Christi.

Cyclone has moved northwestward to Texas coast. CRAIG.

The Acting Chief Signal Officer desires to express his indebtedness to the Rev. Benito Viñes, S. J., of the Belen College Meteorological Observatory, Havana, Cuba, for the timely information furnished this office of the passage of the above-described storm over the region of the West Indies.

VIII.—Another low area appeared in the western valley of the Saskatchewan, near the mountains on the borders of British Columbia, on the night of the 22d. A high area was then advancing eastward from the northern slope. Moving east, with but little energy, it crossed the lakes north of Manitoba on the night of the 23d and on the 24th passed beyond the limits of observation, apparently continuing its progress in the same direction. Its passage so far north was probably due to the high pressure then moving in a similar direction farther south.

IX.—The path of this slight depression was entirely beyond the limits of the United States and can only be approximately located during the earlier translation. The low area was first observed in the western Saskatchewan valley, north of Montana, on the afternoon of the 2[illegible]. Under the influence of the higher pressure to the southeast it moved eastward south of the Saskatchewan, apparently with but feeble energy, and reached the lakes north of Manitoba on the night of the 25th, passing thence beyond the limits of observation. Light local rains attended its passage in the valley and extended southward into Dakota and Minnesota during its progress eastward.

X.—Midnight reports of the 24th indicated the presence of a marked depression off the southern coast of Nova Scotia, which was probably the same disturbance that had been observed off the coasts of the Carolinas on the afternoon of the 23d and had subsequently been forced northeastward over the Gulf Stream by the high pressure advancing from the west. The gradients were marked over the Maritime Privinces and New England. Heavy local rains had fallen over Nova Scotia and Cape Breton, and still continued. Light local rains were reported northward to the Saint Lawrence and in northern New England, and gales had occurred on the southern coasts of the latter. A wind of thirty miles from the northwest was reported at Hatteras, and a maximum velocity of thirty-five miles during the previous eight hours. It moved rapidly northward over southwestern Nova Scotia and eastern New Brunswick, with moderate energy, into the Gulf of Saint Lawrence, where it was central off Chaleur Bay on the afternoon of the 25th. Local rains had fallen from Quebec eastward to the Gulf, in the Maritime Provinces, and northern New England, and still prevailed near the centre of disturbance. Snow also had fallen at Mount Washington, N. H., and in western Maine, and still continued at the former. High winds had occurred at a few coast stations. During the next eight hours the centre of its path apparently trended to the northwest. Subsequently changing direction to the northeast it moved off, north of the Gulf, towards southern Labrador, and was followed by brisk and high winds near the Magdalen Islands.

XI.—On the afternoon of the 25th a belt of pressure below the normal extended from Mexico to the British Possessions; bounded on the west by a line passing diagonally from Yuma through Arizona and Colorado to Cheyenne, and thence passing northwesterly through the eastern portions of Wyoming and Montana it stretched eastward over portions of the extreme northwest, the Missouri Valley, the northwestern border of the west Gulf states, and the Rio Grande Valley. The minimum pressure was over the middle and southern slopes. High areas existed over the Lake region, and in Oregon and Washington Territory. Light local rains had fallen in the region of minimum pressure and adjacent borders. The rapid advance of the high area from the Northwest and the high pressure eastward prevented for a time the development of sufficient energy to cause translation, contracted the area, causing it to assume the general outline of an inverted V, and forced the nucleus of minimum pressure southeastward towards the Gulf, south of San Antonio, Tex., and west of Corpus Christi, Tex., where it was located on the afternoon of the 26th. Frequent light local rains had fallen meanwhile throughout the Mississippi Valley, and still continued. As the high pressure on the east progressed towards the coast the depression began to move towards the northeast. The temperature at this time east of the Rocky Mountains, except in portions of Montana, Dakota, and Minnesota where the abnormal variations were slight, was below the mean, in some instances 18°. Copious local rains consequently continued in the region of the Mississippi from the Gulf northward to the British Possessions, and gradually extended eastward. The centre of disturbance continued to move northeastward, crossed the Mississippi and passed into western Alabama on the afternoon of the 27th, thence trending first to the northward and afterwards to the northwest it passed through western Tennessee, and recrossing the river south of Cairo, Ill., passed into Missouri on the morning of the 28th. Curving crescent-like through the state, the maximum convexity reaching to about the centre, it again crossed the river near Keokuk, Iowa, on the night of the 29th, and at the morning report of the 30th was central in northwestern Illinois, to the southwest of Chicago. Trending thence more to the northward it crossed the lake diagonally to the coast of Michigan, north of Grand Haven, and at the last report on the night of the 30th was central near Grand Traverse Bay, Mich., apparently moving in a direction a few degrees east of north. No marked changes in energy occurred during its translation, but it was attended by abundant rains, the rain belt gradually extending to the east and northeast as the disturbance moved northward, so as to embrace the entire country to the coast south of the Saint Lawrence. By the night of the 31st the rains had ceased both in the west and south, and were confined mainly to localities in the Lake region, northern portions of the middle Atlantic states, and New England. Winds at the close of the month had begun to freshen on the Lakes, and in a few instances had reached velocities considered dangerous to navigation, but had not probably yet reached their maxima.

Another low area was at the midnight report on the 30th apparently central in the western Saskatchewan Valley, north of Montana.

NORTH ATLANTIC STORMS DURING SEPTEMBER, 1887.

[*Pressure in inches and millimetres; wind-force by Beaufort scale.*]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" and from other miscellaneous data received at this office up to October 21, 1887.

Nine depressions are traced, of which five were of tropical or sub-tropical origin; three advanced eastward from the American continent north of the forty-fifth parallel, and one first appeared over the British Isles.

Of the five depressions traced south of the thirtieth parallel, two are given a probable northerly track to the Banks of Newfoundland, from whence one advanced east-northeast to the British Isles; one moved westward over the Caribbean Sea and entered the Gulf of Mexico; one is first charted north of the western extremity of Cuba, whence it moved northeast to the European coast, and one advanced from the vicinity of the Bahama Islands to Nova Scotia and thence recurved eastward. Of the three depressions which advanced over the ocean north of the forty-fifth parallel, one united with a cyclonic area which had moved northward from the tropics; one disappeared northeast of Newfoundland, and one pursued an irregular course from the coast of Labrador and apparently dissipated over mid-ocean south of the fiftieth parallel. The depression which appeared over the British Isles on the 1st advanced northeast beyond the region of marine observations by the 2d.

During the first decade of the month the weather conditions were generally unsettled over the entire ocean, attending the passage of depressions numbers 1, 2, and 3. During the second decade fair weather prevailed over the eastern portion of the ocean, while in mid-ocean and over, and to the southward of, the Banks of Newfoundland stormy weather accompanied the passage of depressions numbers 4, 6, and 7. In the Gulf of Mexico the weather conditions were governed from the 18th to the 21st, inclusive, by depression number 5. During the third decade the weather continued fine east of the fortieth meridian, while over the western portion of the ocean disturbances of small strength were occasioned by depressions numbers 8 and 9.

Compared with the storms traced for corresponding months of previous years, the depressions which appeared during September, 1887, were deficient in number and energy; the paths were confined to more southern latitudes, and while in the region west of the fiftieth meridian the aggregate number of cyclonic depressions of tropical origin somewhat exceeded the average for the month, there was a corresponding decrease in the number which passed eastward over Newfoundland, and an almost entire absence of storms of pronounced strength in high latitudes east of the fortieth meridian.

The following are brief descriptions of the depressions traced:

1.—This storm was central on the 1st between Cuba and southern Florida, whence it circled slowly northeastward to the thirtieth meridian by the 5th, after which it advanced rapidly northeastward and disappeared over the northern portion of the British Isles after the 8th. This depression displayed small energy during its passage off the Florida coast; with its advance over the ocean, however, it occasioned heavy rains and fresh to strong gales.

The following special reports refer to this depression: Capt. D. W. Storer, of the brig "Abbie Clifford," reports: "August 31st, 2.30 p. m., in N. 25° 10′, W. 80° 00′, a heavy squall from e., with heavy rain and very black weather; the wind died out as the rain ceased. At night the wind increased, and at midnight was blowing from ene., force 8. From the 1st to the 5th of September, between the above position and N. 28° 30′, W. 80° 00′, experienced unsettled weather, with frequent se. to ne. gales of force 7 to 8, and rain in squalls. Capt. C. W. Möller, of the s. s. "Geiser," reports a gale on the 7th and 8th, between N. 54° 44′, W. 26° 32′, at noon of the 7th, and N. 56° 39′, W. 19° 24′, at noon of the 8th; wind shifted from w. by s. to ssw., and veered to nw. by n.; lowest barometer, 29.25 (743.0), at midnight of the 7th, in N. 55° 46′, W. 22° 50′, when wind was ssw., force 9.